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AUTHOR Rahmlow, Harold F.
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ABSTRACT

A mode of operation that is currently being utilized for research and development activities in a nontraditional college environment is presented. The program described is in the content area of mathematics of life insurance. The students for whom the materials were developed are adults in insurance and related professions who are engaged in full-time work activities at the same time they are continuing their education. The design and evaluation of the program took into account cognitive, affective, and operational variables. The program is the Chartered Life Underwriter Diploma Program (C.L.U. Diploma Program) of the American College, which consists of 10 semester-length courses each of which culminates in an examination. Two data bases were used--one from biographical data and one from test data. As a result of context and input evaluations, it was decided to develop an individualized learning experience with the following key structural elements: specifically stated behavioral objectives, criterion referenced test items, guidance information and learning activities designed to elicit performance of objectives. The new mathematics of life insurance modular learning experience is designed to supplement existing study aids from the American College. The program consists of seven booklets, one for each of the seven assignments in the mathematics of life insurance section of C.L.U. Course 1, and one specially indexed audio tape. The test used for evaluation of the program consisted of two forms of an examination prepared by the program developers, and the California Multiple Aptitude Test in Numerical Reasoning. (DB)

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Mathematics of Life Insurance Study Aid Development and Evaluation in a Nontraditional Setting

Harold F. Rahmlow

The American College of Life Underwriters
270 Bryn Mawr Avenue
Bryn Mawr, Pennsylvania 19010

AC014156

Mathematics of Life Insurance Study Aid Development and Evaluation in a Nontraditional Setting

Harold F. Rahmlow

The emergence of nontraditional educational programs is creating new problems and opportunities for persons engaged in educational research and development activities. It is the purpose of this paper to present a mode of operation that is currently being utilized for research and development activities in a nontraditional college environment. The program that is described is in the content area of mathematics of life insurance. The students for whom the materials were developed are adults in insurance and related professions who are engaged in full-time work activities at the same time they are continuing their education. These persons view their educational work experiences as professional growth opportunities. The design and evaluation of the program took into account cognitive, affective and operational variables.

A Nontraditional Setting

The American College is an institution of higher learning with a tradition of nontraditional study (Rahmlow, Spectator, 1972). Currently the College has approximately 40,000 adults actively engaged in its educational programs. The Chartered Life Underwriter Diploma Program (C.L.U. Diploma Program)

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consists of 10 semester-length courses each of which culminates in an examination. The candidates of the American College live throughout the United States and, in fact, throughout the world. In the C.L.U. Diploma Program approximately one half of the candidates study in a formal class structure while the remaining 50 percent study either in informal study groups or as independent learners. Most development and research activities associated with the American College's programs are carried out on its campus in Bryn Mawr, Pennsylvania.

Needs Analysis

For some time it has been conventional wisdom among students and teachers associated with the American College that the mathematics of life insurance area is one of the more difficult areas of study in the College's programs. As a result of data from this large but unsystematically generated data base, it was decided to proceed with a more systematic context evaluation to determine whether or not there was a need for a new learning experience. Two data bases were used, a data base generated from biographical data and a data base generated from test data. The first and grossest use of the data was to consider the passing ratio for candidates taking the Individual Life and Health Insurance Course (Course 1) compared with those taking other courses. In addition to this general comparison, item analysis of individual items was made and results compared by subtests. The 100 item examination for Course 1 is broken down into five subtests according to content areas. Two subtests of the one examination accounted for all of the items and only those items related to this study. An analysis of the responses of almost 6,000 subjects indicated that for the January 1971 examination of Individual Life and Health Insurance the mean was 69.5 with a standard deviation of 12.6. In contrast, the two

subtests containing mathematics items had means of 17.4 on a base of 27 and 13.2 on a base of 21 items. Translated into terms of difficulty, the total test had a level of difficulty of 69.5 while the two mathematics subtests had levels of 64.3 and 62.3.

An analysis of item difficulty response set and an inspection of the items themselves did not indicate that faulty items were contributing significantly to the degree of difficulty of the mathematics subtest. However the results did indicate that the mathematics items were more than average difficulty, and that they discriminated well in comparison with items in the remaining subtests. To evaluate the homogeneity of subtests a factor analysis was carried out. The analysis produced 24 factors which accounted for 35 percent of the common variance. While the factors did not correspond uniquely to the subtests, items related to mathematics loaded heavily on the factors. The analysis indicated that there were, in fact, factors that could be labeled mathematics factors.

It has also been found that once a candidate fails to take an examination he has signed up for or takes that examination and fails, he is less likely to continue with his studies. An earlier study (Woodley, 1971) indicated that the attrition rate for candidates in Course 1 was approximately 50 percent higher than for C.L.U. Courses in general. (Attrition is defined as signing up for an examination but failing to take or canceling registration for that examination.) Since Course 1 is the course that is taken first by the overwhelming majority of C.L.U. candidates and since early success has been shown to lead to subsequent successes, and likewise failure to failure, it is vital

that learning resources be available to encourage candidates to successfully complete their first course.

The context evaluation indicated that students were having sufficient difficulty with mathematics of life insurance and that the course itself was of sufficient importance to warrant the development of a learning experience.

A data base was also generated from the candidates' registration forms. These data included: date of birth, current occupational position, year of beginning an insurance career, year of matriculation with the College, year of last examination, level of formal education and method of preparation for each examination for which the candidate had registered.

An input evaluation using biographical data helped to determine a structure for the learning experience. Specifically it was found that all students had at least a high school education. Of those who took the Individual Life and Health Insurance examination in January of 1971, 47 percent held Bachelors Degrees and an additional 29 percent had some College, the remaining 24 percent had no college. A comparison of the educational level with examination performance did not conclusively establish a causal relationship, but there did appear to be an interaction between level of education and success on the examination. An analysis indicated that approximately 45 percent of the population prepared without participating in a formal class. This information strengthened the need for a flexible learning experience, one that would go into sufficient depth and provide sufficient diagnostic information to be of benefit to the independent learner and yet structured so that it could be used in a group situation.

Instructional Design

As a result of the context and input evaluations, it was decided to develop an individualized learning experience with the following key structural elements: specifically stated behavioral objectives, criterion referenced test items, guidance information and learning activities designed to elicit performance of objectives.

The new mathematics of life insurance modular learning experience is designed to supplement existing study aids from the American College. Emphasis is placed on facilitating the student's ability to pinpoint and concentrate his study on areas of specific difficulty. The program consists of seven booklets, one for each of the seven assignments in the mathematics of life insurance section of C.L.U. Course 1, and one specially indexed audio tape. To facilitate identification of specific learning areas, the materials have been organized around a set of instructional objectives and reference materials are correlated with objectives. The program design is shown in figure 1 as described below.

Insert figure 1 about here

Each booklet contains a table of contents of instructional objectives, and the learning materials associated with each objective have been designed with five essential features. These features as shown in figure 1 are: (1) an objective, (2) an example that takes the form of a test item, (3) an instructional section, (4) at least one summary type question and (5) an answer sheet that provides confirming feedback. Within the instruction section (3) there are

various combinations of specific references to commercially available texts, specially written materials and an audio tape. The reference used depends on the nature of the material being presented and the appropriateness of already existing commercially available material. Adjunctive questions are also included to assist candidates in study and to clarify points of difficulty. In the confirming feedback section (5) the correct answers are provided for the test item and the summary question. Where appropriate, answers are also provided for the adjunctive questions from the instructional section. Figures 2 and 3 show a portion of the material for two objectives. The instruction section for objective 12.11 (figure 2) shows the combined use of a commercially available text and specially written materials designed to supplement the text. For Objective 10.10 (figure 3) a combination of specially written materials and an audio tape is used.

Insert figure 2 about here

The audio tape referenced in figure 3 represents a new concept in audio instructional design that employs Zimdex, an audio indexing system developed by the American College which allows the candidate to quickly locate a particular segment of instruction.

Insert figure 3 about here

Program Development and Evaluation

Essentially the program was conceived and developed over an 18 month period. Figure 4 highlights the flow of developmental activities. Reference

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Insert figure 4 about here

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has already been made in previous paragraphs of this paper to the needs analysis and instructional design of the program. The development of the program itself was carried out by a team consisting of subject matter experts, educational psychologists and writers. Instructional objectives and sample test items were developed simultaneously for the program. These objectives were derived from existing course material. Subsequent to the development of the objectives and test items, the didactic material and adjunctive program materials were developed. Initial developmental testing of the program was carried out on a small sample of students at the American College in January 1972. Following this developmental testing the materials were revised for further testing. The second formative evaluation of this supplementary study material was carried out in the Spring of 1972. A small sample of students worked on campus in a relatively controlled environment. Because the materials would ultimately be used in a nontraditional setting, that is by adults in and out of formal class sessions throughout the nation, a larger sample of students worked in a field environment almost identical to the environment under which the program would be utilized. A system of 15 volunteer assessment centers was established to provide a controlled environment in which to test the program. In the following paragraph

highlights of the second formative evaluation are presented. These highlights are abstracted from the work of Andrulis (Andrulis, 1972).

The design utilized for this evaluation was similar to the separate sample pretest/posttest design (Campbell and Stanley, 1963). Since the program was still undergoing some formative evaluation, accommodation to the design was made. This accommodation included the identification and selection of students to participate in the use of the course at the Bryn Mawr campus under the tutorship of the developers. The remaining groups of students who utilized this program were mailed materials.

The test used for evaluation of the mathematics program consisted of two forms (Form A and Form B) of an examination prepared by the developers of the program to reflect the objectives and content of the program. In addition, a test entitled California Multiple Aptitude Test in Numerical Reasoning produced by the California Test Bureau McGraw/Hill was also used. The test included two parts: Test 5 on Arithmetical Reasoning and Test 6 on Arithmetic Computation. These examinations were paired with the in-house examination so that form A-test 5 and form B-test 6 were used in combination in one examination setting for each student. These two pairs of tests were then randomly administered in both pretest and posttest conditions.

In addition to the examinations a mathematics program questionnaire was also prepared. Generally this questionnaire reflected general usage of the program by students as well as descriptive information as to students' characteristics and finally some attitudinal information with regard to reaction toward the content area encompassing rate making and calculations. The last area of attitudinal reaction toward rate making and calculation followed the Semantic Differential Technique developed by Osgood (Snider and Osgood, 1969).

The degree of participation by the students in this program was not as high as we would have liked. Of the 20 students that were identified and elected to accept the invitation to participate in the control group of this design, only two actually went to the correct testing center and received both sets of the examination. Because of the limited number of individuals in this case the control group was eliminated. However, because the administration of the test included alternate forms of the test developed by the curriculum developers on the Bryn Mawr campus, a control group was nevertheless established.

An analysis of variance performed on the data indicated that for tests A and B there was significant growth and change in performance for users of the program from the pretest to posttest situation ($F = 5.24$, $P < .05$ df. 1, 51) However, the results comparing the pretest situation and the posttest situation for those who took test 5 and 6 of the California Achievement Test Series indicated there was a significant decrease in knowledge from the pretest to posttest situation. The rationale for this finding is based on the minimum overlap between the California Achievement Test Program and the mathematics program. The California Achievement Test Series was used specifically to observe changes in behavior for students on selected test items and not to make a final evaluation of the effects of the mathematics program.

In addition to the above analysis, a comparison was also made of the test scores of the June 1972 National C.L.U. Examination for individuals who participated in the design and all those who took the Course 1 final examination. The students who were pre or posttested and who used the mathematics program did significantly better than the norm group for both the total Course 1 test and the math subtest to the examination.

The results of the questionnaire and the attitudinal rating are not presented here in detail but rather, interested readers are referred to the Andrulis study. In general the questionnaire provided information which was useful in making final revisions of the mathematics materials.

Implications

The significance of this developmental effort goes far beyond the supplemental mathematics of life insurance study materials that were produced. The paper has described a data based systems approach to developing learning materials. In the emerging open university or nontraditional context of higher education, it is becoming increasingly important to have a systematic method for developing and validating learning materials. Students are located in geographically diverse areas and individual faculty members cannot frequently interact on a one-to-one basis or even on a many-to-one basis with students. There is little time for ad hoc adjustment of curriculum materials. The learning materials must be carefully thought through and speak to a specific need, lest they cause a great deal of hardship for students throughout the nation.

The necessity for even more careful planning in developing learning experiences for nontraditional study will undoubtedly have its impact on traditional educational institutions. If these carefully thought out and systematically developed learning experiences are indeed superior to ad hoc courses developed by individual professors on campuses, results in terms of student learning will become evident. If, on the other hand, superior results are not evident those of us who believe in the systematic development of instructional materials are in for a great deal of soul searching.

FIGURE 1

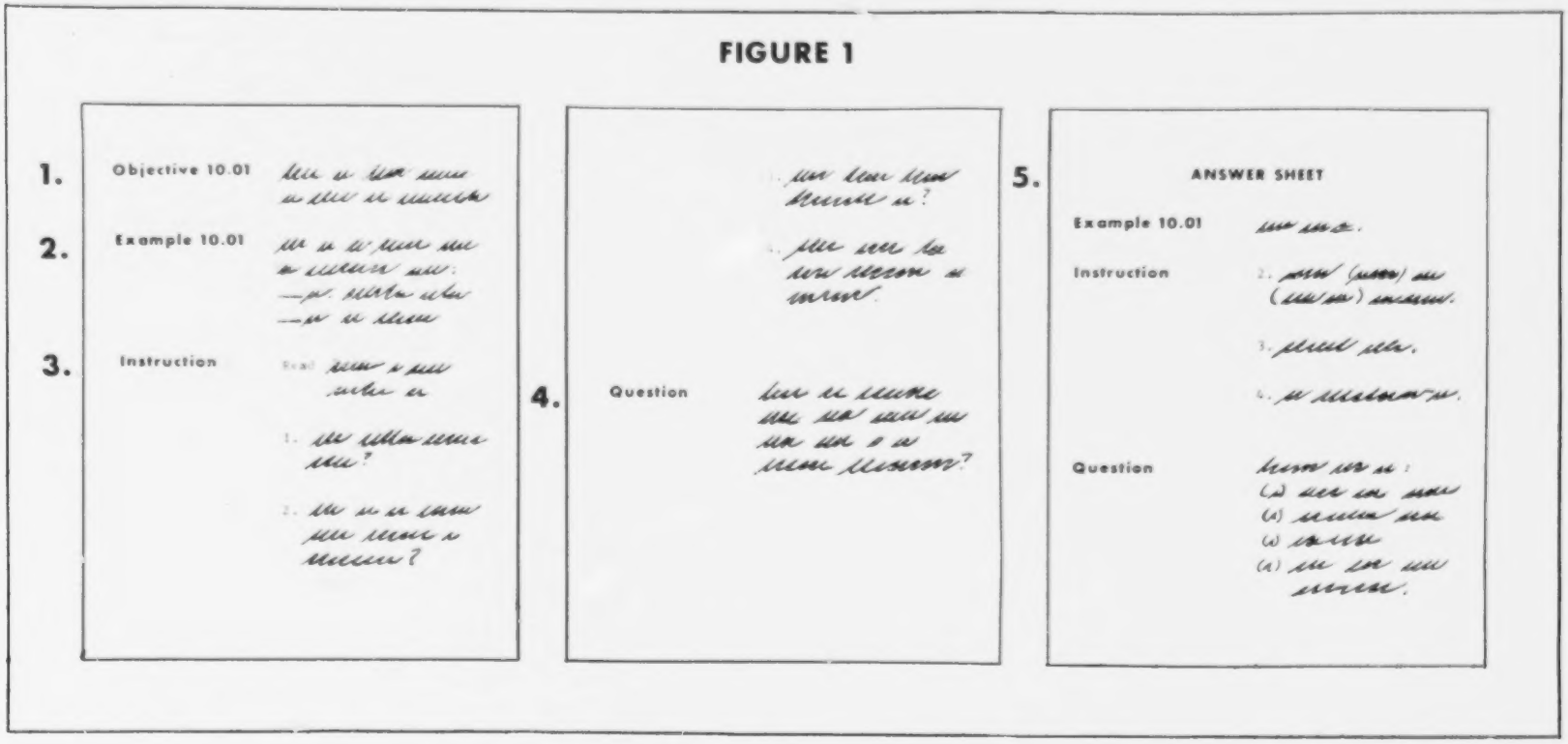

1.
Objective 10.01
2.
Example 10.01
3.
Instruction
4.
Question
5.
ANSWER SHEET
Example 10.01
Instruction
Question

Figure 2

OBJECTIVE 12.11 — Given the necessary information, set up and label the equations that would be used to calculate the net single premium for an immediate temporary life annuity.

EXAMPLE 12.11 — Using the tables on pages 12.21 and 12.22 and the aggregate approach, set up the equations that would be used to calculate the NSP for an immediate five-year temporary life annuity of $100 per year, at 2½% interest, issued to a person age 70.

INSTRUCTION — Read LIFE INSURANCE
Huebner & Black
pages 358 to 362

and

IT IS IMPORTANT TO REMEMBER THAT THE WORD "IMMEDIATE" MEANS THAT THE FIRST ANNUITY PAYMENT WILL BE MADE ONE YEAR OR TIME PERIOD FOLLOWING THE INCEPTION OF THE CONTRACT. FOR EXAMPLE, AN ANNUITY PURCHASED AT AGE 50 WOULD BE CALCULATED ON THE PROBABILITY OF THE FIRST PAYMENT BEING MADE ONE YEAR FROM THE DATE OF PURCHASE OR AGE 51. THE SECOND PAYMENT WOULD BE CALCULATED ON THE PROBABILITY OF THE ANNUITANT BEING ALIVE AT AGE 52, AND SO ON.

1. An immediate temporary life annuity promises to pay the annuitant a certain sum on each anniversary date of purchase, each year, for a period of years

___ A. only if the annuitant is still living.
___ B. whether the annuitant is living or has died during the year.

2. The probability insured against is the probability that the annuitant

____ A. will survive each year.
____ B. will die during the year.
____ C. will die or survive during the year.

3. Which of the following mortality tables would be used to calculate the NSP for annuities?

____ A. 1958 CSO Table
____ B. 1949 Annuity Table

4. Why doesn't an insurance company use the same mortality table for insurance and annuities?

5. Using the tables on pages 12.21 and 12.22 and the probability approach, set up and label the equations that would be used to calculate the NSP for an immediate three-year temporary life annuity policy of $100, at 2½% interest, issued at age 63.

6. Using the tables on pages 12.21 and 12.22 and the aggregate approach, set up and label the equations that would be used to calculate the NSP for an immediate three-year temporary life annuity of $200, at 2½% interest, issued at age 75.

QUESTION

Using the tables on pages 12.21 and 12.22 and the probability approach, set up and label the equations that would be used to calculate the NSP for an immediate four-year temporary life annuity of $500, at 2½% interest, issued at age 60.

Figure 3

OBJECTIVE 10.10

Use a table of compound interest functions to determine the present value of a given amount at the end of a given number of years.

EXAMPLE 10.10

According to Table I, which of the following values is the present value of $1,000 payable at the end of 5 years?

____ A. $643.93
____ B. $956.94
____ C. $802.45
____ D. $1,045.00

INSTRUCTION

1. For this portion of the instruction, you will need Table I and a cassette recorder. After you have assembled these materials, turn on the tape -- Zimdex #245.

FIGURE 1

$1 x .915730 = $.915730

FIGURE 2

$500 x .915730 = $457.86

FIGURE 3

$457.86 x 1.092025 = $500.00

FIGURE 4

$2,000 x .516720 = $1,033.44

ANSWER SHEET

EXAMPLE 10.09 The answer is: "D".

INSTRUCTION The answers are:

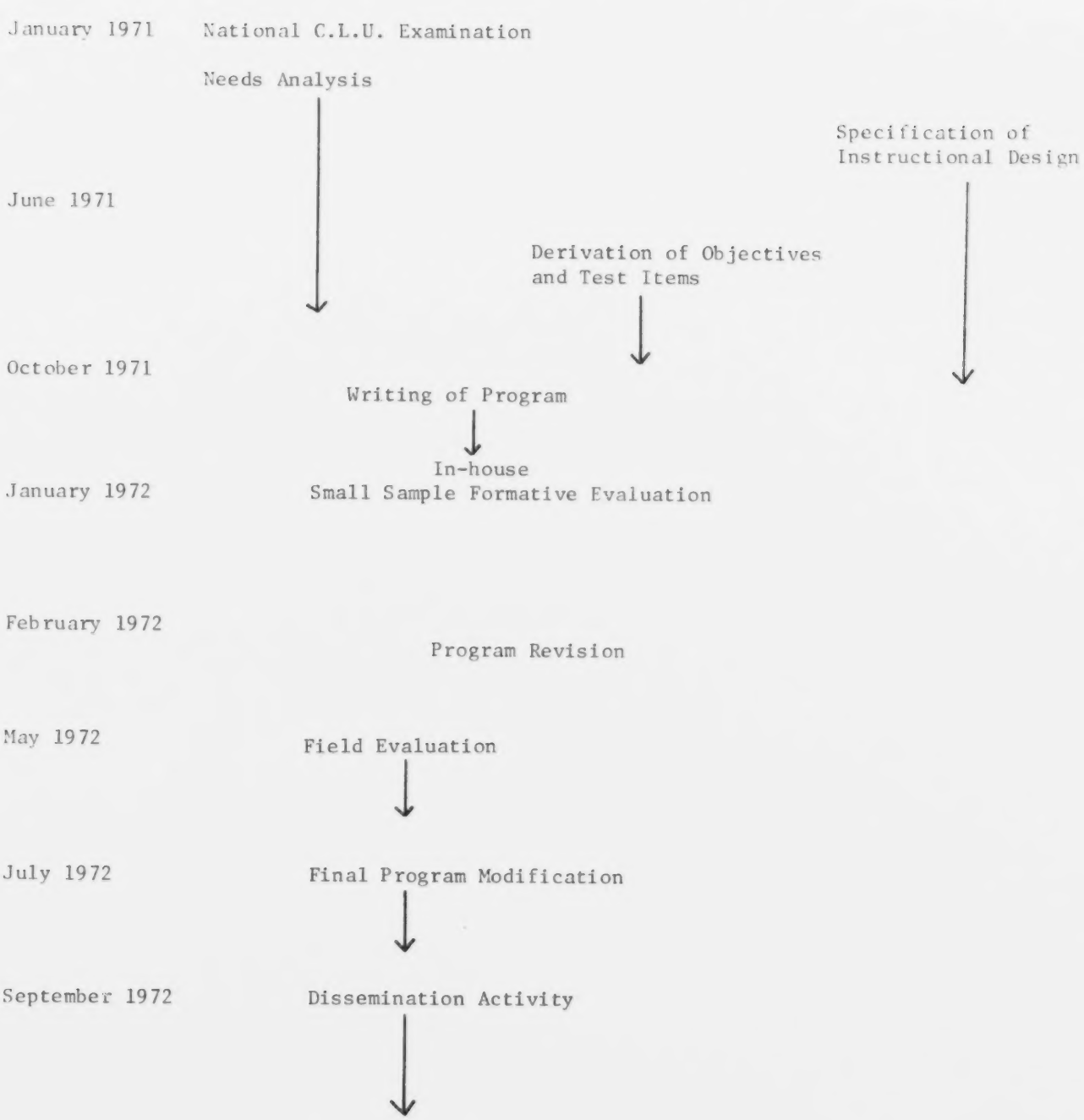
2. "D"

3. (a) .876297
   (b) .767896
   (c) .672904

QUESTION The answers are:

(a) .915730
(b) .734828
(c) .643928

FIGURE 4


January 1971
National C.L.U. Examination
Needs Analysis
Specification of
Instructional Design
June 1971
Derivation of Objectives
and Test Items
October 1971
Writing of Program
In-house
January 1972
Small Sample Formative Evaluation
February 1972
Program Revision
May 1972
Field Evaluation
July 1972
Final Program Modification
September 1972
Dissemination Activity

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